# IMPLEMENTATION AND COMPARISON OF PYTHON AND FLUTTER BASED QNACHATBOT WITH CLOUD SERVICE

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## ABSTRACT

*Human to machine conversation is made by using a chatbot. Nowadays the use of chatbots is very popular, as a large scale of applications, especially in systems that provide an intelligence support to the user. Chatbots appeared in large numbers at the beginning of the current decade. Interactive technology, often combined with artificial intelligence, has rapidly invaded and occupied the world of online chat. Chatbots are not just elements of virtual assistants, but are used by organizations and governments on websites, in applications, and instant messaging platforms to promote products, ideas or services. This paper mainly compares the QnAbot cloud service and the QnAbot with the local service developed in Python and the Graphical User Interface with Flutter language and shows that using python service we can achieve better results with better accuracy and better response times at low cost when compared with the existing cloud set up for the QnAbot.*

*KEYWORDS: Keyword based, QnAbot, Chatbot, Cloud Service & NLTK*

## 1. INTRODUCTION

Nowadays the use of virtual assistants has increased a lot as the amount of data has increased and the number of customers has also increased and the organizations are unable to cater the needs or support the customers in real time. There are different types of virtual assistants available. Some of them are as follows: chatbots, QnA chatbots Interactive Voice Response System (IVRS) and etcetera., and these days the hosting of QnA Chatbots is done in cloud environments like Google Cloud Service, Microsoft Azure Services, Amazon Web Services, etc. and these services will cost very huge expenditure to the individual or organization. So, in this paper, we are going to describe how a python based QnA Chatbot can be used instead of cloud based services. However, continuous attempts and analysis in this field have led to the process to be automated to some extent. The further plan is to automate this process. This chapter introduces the way that a QnA Chatbot can be used to resolve the user queries.

At the basic level, a QnAchatbot is a computer program that simulates and processes human conversation (either written or spoken), so that it allows humans to interact with digital devices as if they were communicating with a real person. QnA Chatbots can be as simple as rudimentary programs that answer a simple query with a single-line response, or as sophisticated as the digital assistants that learn and evolve to deliver increasing levels of personalization as they gather and process information.

The main task of a QnAChatbot is to understand the query given by the user based on the keywords used in the user input query and perform the task based on the understanding. This understanding for the chatbot requires preprocessing, comparing the query with the dataset, evaluating the score and finalizing the understanding

of query capabilities. And should be able to perform some predefined set of tasks, based on the understanding of the user input query and response for the same.

Pre-processing is a method where we clean the data and filter out unwanted content from the data. That is to remove the words which are not necessary for the understanding, like punctuation marks, unnecessary spaces, repeated words, single characters, special characters etc.

After preprocessing the user input query, comparison of the preprocessed content with the dataset is done and the evaluation is also done in order to find the perfect operation or reply for the given input user query.

## 2. LITERATURE REVIEW

In the paper [1], Liebrecht, C, has presented the use of chatbot for explaining how the communication style of a chatbot can impact or shows the brand attitude and the quality of interaction. He has used the flow.ai module for using the chatbot.

In the paper [2], Ruane, E, has presented the text-based chatbot to explain how the user perception can affect based on the chatbots word usage. In this two versions of chatbots are design in that one is intra and extra. It uses Microsoft Bot Framework.

In the paper [3], G. Daniel, has presented the use of chatbot which is effectively designed to the specific data using xatkit: a multimodal low-code chatbot development framework.

In the paper [4] Wang, has presented the use of chatbot for showing the advantages and constraints of a hybrid model k-12 e-learning assistant chatbot. Which uses the retrieval based model and QANet Model.

In the paper [5] Rudra Boppuru, Prathap has presented the use of word based approach for polarity detection on the real-time news data for the comparison between multiple news articles. Where he has gathered the data from various online sources, it uses Latent Dirchlet Algorithm to identify the topic of article which is also known as topic modelling technique.

In the papers given above they have used some or the other online module or online cloud services for the use of chatbot algorithm and that is where they send api calls and fetch responses and it takes time to get responses. And it makes very high cost to the organizations for the use cloud services on the regular basis. So, in this paper we are using the technique used in paper [5] for the sentiment detection. But in this paper it is used for the purpose of word detection and matching with the given dataset in order to identify the appropriate reply to the input text given by the user via mobile app or web app using Http requests.

## 3. METHODOLOGY

Chatbots have become an important topic of study in recent years due to its wide range of applications. These days many new websites and organizations are popping up daily and it has become difficult for the organizations to support or help with the issues faced by the customers at a fast pace. So, it is a better option to integrate a virtual assistant also known as QnAChatbot for the faster resolution to the problems faced by the customers on a daily basis.

This project, suggests to set up a QnAChatbot in a website for better results instead of using a cloud based setup. which will burn a hole in organizations pockets. This project's methodology targets low cost and effective methodology with far better results when compared to cloud based solutions.

In this project, the algorithm extracts the preprocessed data from the user given input. This project uses the following techniques and methods for successfully achieving the above mentioned objectives.
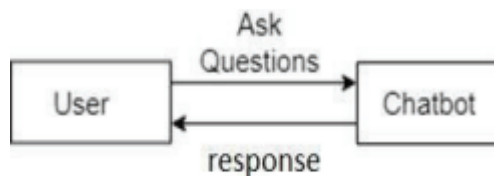


**1. HTTP (Hypertext Transfer Protocol)**

It is an application layer protocol used for sending and receiving data to and fro from the server. Using this protocol the data is transmitted between the algorithm and web application or mobile application.

**2. NLTK (Natural Language Toolkit)**

Platform from python is used to remove stop words from the given text. There is a universal list for stop words. Instead, the NLTK module has a list of stop words which is used to remove stop words from a given text.

**3. Stop Words Removal**

The stop words like a, an, the, this which are not useful in performing the sentimental analysis is removed by pre-processing the data.(NLTK python library for stop words)

**4. Removal of Special Characters**

The special characters are also removed by preprocessing the extracted data.

**5. Removal of Repeated Words**

If a word is repeated more than once then the repeated words are removed by preprocessing the data which will not be useful while performing the detection of appropriate response based on the input text given by the user.

**6. Removal of Double Spaces in between the Words**

If the words have double spaces in between them they can be replaced with single space by preprocessing the extracted data.

**7. Word Dictionary**

The Word Dictionary is created with the help of using standard data present on online resources. In this project pre-defined datasets are used for the standard questions and answers belonging to a scenario

**8. Keyword Based Approach**

It is a technique used to determine the perfect match of response suiting to the user query. This uses the process of word by word matching with the existing dataset and gives response based on the highest matching percentage.
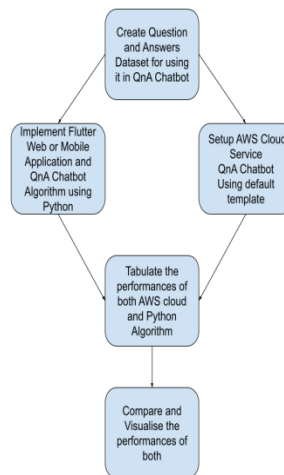
**Figure 1: Different Phases of the Project**

Figure-1, explains the different phases present in the project. Firstly, creation of dataset is done for using it in QnAChatbot. Then, secondly the implementation of Flutter based web and mobile app, and QnAChatbot Algorithm using python is done. And along with this, parallely the setup of AWS Cloud Service QnAChatbot using default template is done. Thirdly, the tabulation of the performances of both AWS Cloud Service and Python Algorithm done. The performance measures include like response time, accuracy, etc. Then finally, the tabulated data is used for comparison and visualisation of both the setup.

### A. Proposed Architecture

In Figure-2, the Excel file is used as the dataset. Mobile App or Web App is used as the User Interface for communicating with the chatbot and raise questions to it. Chatbot algorithm is included in the flask server itself in order to decrease the latency between flask and chatbot algorithm. Where flask server is very light-weight REST API server developed to use with Python. This flask server is responsible for establishing the communication with the Web app or mobile app. This communication happens using the Hypertext Transfer Protocol (HTTP) requests between them. Chatbot algorithm internally uses default python based file access operations to access and read the excel dataset in order to compare the user given input text with the data present in the dataset.
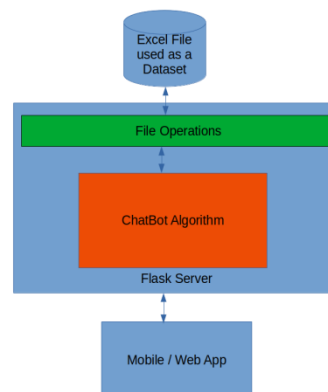


**Figure 2: Proposed Architecture.**

**Table 1: Sample Dataset**

| Question | Answer |
|---|---|
| Hi How Are you? | I am Good. |
| what type of products do you have? | We have different Electronic Products like washing machines, TVs, refrigerators, Air Conditioners, Microwave ovens, etc |
| which product is sold the most? | TVs are the most sold products |
| what all things you can do? | I can answer all your facts and queries |

Here the Table-1 given above Shows the sample data used in the dataset.

## 4. RESULTS AND DISCUSSIONS

The proposed chatbot is efficient enough for replying to the user with appropriate reply based on the input text given by the user. It is also giving the better results when compared with the AWS QnA Chatbot Cloud Service which is a paid service. The proposed algorithm performs well in both accuracy measure and the average response time as this is integrated inside the flask server itself. But in the case of AWS Servers we have to setup one server for serving the website and the other thing is we have to use api calls to the QnA Cloud Service internally due to which there is a delay in the responses we get from the api calls and this in turn should be returned to the web app or mobile app whichever invoked the call to the flask server. All this is achieved in a low cost set up.

## 5. CONCLUSIONS

**Table 2: Results of Performance Measures of Both the Setups**

| | Accuracy in Percentage | Average Response Time in Seconds |
|---|---|---|
| **AWS QnAbotChatbot** | 95.6 | 1.36 |
| **Python based QnAbotChatbot** | 97.8 | 0.72 |

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In the above mentioned Table-2 it shows us the results of both the setups, wherein we can see that the proposed algorithm is more accurate than the AWS cloud service.

| AWS Service | Dimensions | Cost |
|---|---|---|
| Amazon API Gateway | 1,000,000 RESTAPI per month | $3.50 |
| Amazon Cognito | 1,000 active users per month without the advanced security feature | $0.00 |
| Amazon CloudFront | 1,000,000 requests — 1 request per download with the static bucket size of 100KB and approximately 20GB data transfer | $8.50 |
| Amazon S3 | 100GB data transfer + 1,000,000 requests — 100 records x 100KB from Kinesis | $3.27 |
| AWS Lambda | 2,000,000 requests with 200ms duration | $1.23 |
| Systems Manager Parameter Store | 2,000,000 requests with 10 standard parameters | $0.00 |
| Amazon Lex | 100,000 text requests per month | $75.00 |
| Kinesis Data Firehose | 100,000 records per month with 100KB per record | $0.28 |
| Amazon DynamoDB | 1GB storage + 1 read and 1 write per second + 20 hours peak read/write per month | $11.41 |
| Amazon Polly | 10,000 requests + 50 characters per request | $4.00 |
| Amazon Translate | 100,000 requests + 50 characters per request (OPTIONAL for non-English) | $75.00 |
| Amazon Comprehend | 100,000 requests + 50 characters per request | $5.00 |
| Amazon OpenSearch Service | M6g.large instance running all hours in a month for 4 nodes | $368.64 |
| | TOTAL: | $552.33/ month |

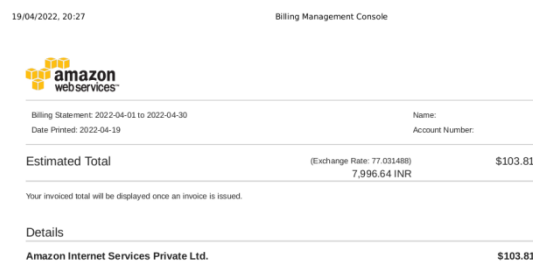**Figure 3: Table of Amazon Web Services Cost Estimation per Month.**



**Figure 4: Cost Incurred after the use of AWS QnAChatbot for one Week.**

In above given pictures Figure-3 shows us the estimated cost of 552.33 USD which is around 42,644.48 INR. And Figure-3 shows us that the estimated total of 7,996.64 INR for the usage of Services in 1 week duration.
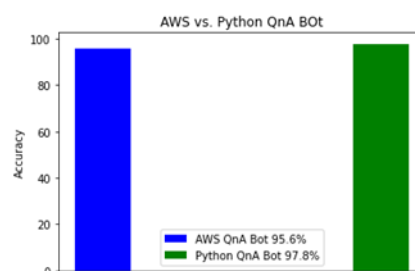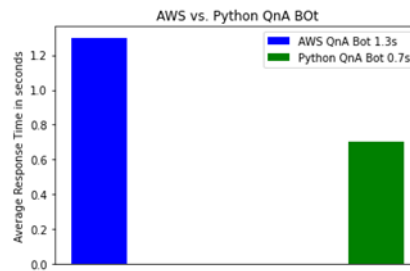


**Figure 5: Accuracy Graph.**
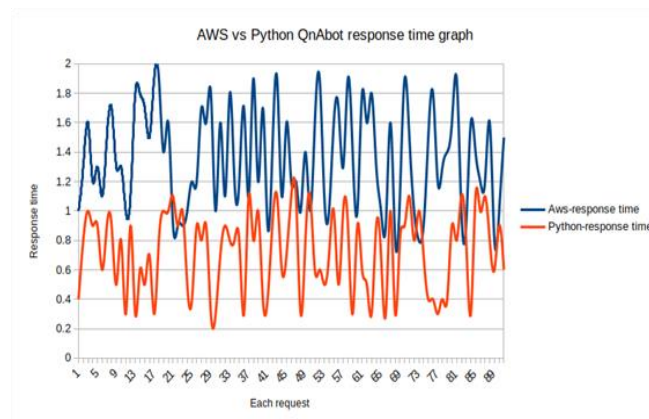
**Figure 6: Average Response Time Graph.**



**Figure 7: Response Time Graph.**

In the above given Figures, Figure 5 shows the Accuracy graph, Figure 6 shows the average response time graph and Figure 7 shows the Response time graph of each requests passed between AWS and Proposed QnABot.

In this paper the custom built python based algorithm is efficient enough to tackle the user queries and performs well and also yields better results when compared with the AWS Cloud Service. And this is easy to integrate and change the dataset easily if required. Currently this algorithm supports only English and does not support the use of other languages. But we can implement the support for a new language if the word dictionary of the same new language is gathered and fed to the algorithm. This efficiency can also be further increased with use of some SQL database instead of excel file for datasets. By using SQL database we can perform complex queries. And also by this we can give more number of data and also we can include multiple websites with multiple domain questions.

*REFERENCES*

1. *Liebrecht, C., Sander, L., van Hooijdonk, C. (2021). Too Informal? How a Chatbot's Communication Style Affects Brand Attitude and Quality of Interaction. In:, et al. Chatbot Research and Design. CONVERSATIONS 2020. Lecture Notes in Computer Science(), vol 12604. Springer, Cham. https://doi.org/10.1007/978-3-030-68288-0_2*

2. *Ruane, E., Farrell, S., Ventresque, A. (2021). User Perception of Text-Based Chatbot Personality. In:, et al. Chatbot Research and Design. CONVERSATIONS 2020. Lecture Notes in Computer Science(), vol 12604. Springer, Cham. https://doi.org/10.1007/978-3-030-68288-0_3*

3. *G. Daniel, J. Cabot, L. Deruelle and M. Derras, "Xatkit: A Multimodal Low-Code Chatbot Development Framework," in IEEE Access, vol. 8, pp. 15332-15346, 2020, doi: 10.1109/ACCESS.2020.2966919.*

4.  E. H. -K. Wu, C. -H. Lin, Y. -Y. Ou, C. -Z. Liu, W. -K. Wang and C. -Y. Chao, "Advantages and Constraints of a Hybrid Model K-12 E-Learning Assistant Chatbot," in IEEE Access, vol. 8, pp. 77788-77801, 2020, doi: 10.1109/ACCESS.2020.2988252.

5.  Rudra Boppuru, Prathap & Kokatnoor, Sujatha & Yadav, Chandragiri & Mounika, Mummadi.(2020). Polarity Detection on Real-Time News Data Using Opinion Mining.10.3233/APC200124.

6.  X. Ren, G. Spina, S. De Vries, A. Bijkerk, B. Faber and A. Geraedts, "Understanding Physician's Experience With Conversational Interfaces During Occupational Health Consultation," in IEEE Access, vol. 8, pp. 119158-119169, 2020, doi: 10.1109/ACCESS.2020.3005733.

7.  R. Rajkumar and V. Ganapathy, "Bio-Inspiring Learning Style Chatbot Inventory Using Brain Computing Interface to Increase the Efficiency of E-Learning," in IEEE Access, vol. 8, pp. 67377-67395, 2020, doi: 10.1109/ACCESS.2020.2984591.

8.  Croes, E.A.J., Antheunis, M.L. (2021). 36 Questions to Loving a Chatbot: Are People Willing to Self-disclose to a Chatbot?. In:, et al. Chatbot Research and Design. CONVERSATIONS 2020. Lecture Notes in Computer Science(), vol 12604. Springer, Cham. https://doi.org/10.1007/978-3-030-68288-0_6

9.  vanWezel, M.M.C., Croes, E.A.J., Antheunis, M.L. (2021). "I'm Here for You": Can Social Chatbots Truly Support Their Users? A Literature Review. In:, et al. Chatbot Research and Design. CONVERSATIONS 2020. Lecture Notes in Computer Science(), vol 12604. Springer, Cham. https://doi.org/10.1007/978-3-030-68288-0_7

10. E. H. -K. Wu, C. -H. Lin, Y. -Y. Ou, C. -Z. Liu, W. -K. Wang and C. -Y. Chao, "Advantages and Constraints of a Hybrid Model K-12 E-Learning Assistant Chatbot," in IEEE Access, vol. 8, pp. 77788-77801, 2020, doi: 10.1109/ACCESS.2020.2988252.

11. B. Srivastava, F. Rossi, S. Usmani and M. Bernagozzi, "Personalized Chatbot Trustworthiness Ratings," in IEEE Transactions on Technology and Society, vol. 1, no. 4, pp. 184-192, Dec. 2020,doi: 10.1109/TTS.2020.3023919.

12. L. Zhang, Y. Yang, J. Zhou, C. Chen and L. He, "Retrieval-Polished Response Generation for Chatbot," in IEEE Access, vol. 8, pp. 123882-123890, 2020, doi: 10.1109/ACCESS.2020.3004152.

13. R. Rajkumar and V. Ganapathy, "Bio-Inspiring Learning Style Chatbot Inventory Using Brain Computing Interface to Increase the Efficiency of E-Learning," in IEEE Access, vol. 8, pp. 67377-67395, 2020, doi: 10.1109/ACCESS.2020.2984591.

14. S. Punjabi, V. Sethuram, V. Ramachandran, R. boddu and S. Ravi, "Chat bot Using API : Human To Machine Conversation," 2019 Global Conference for Advancement in Technology (GCAT), 2019, pp. 1-5, doi: 10.1109/GCAT47503.2019.8978336.

15. G. Saqib, K. Faizan and N. Ghatte, "Intelligent Chatting Service Using AIML," 2018 International Conference on Current Trends towards Converging Technologies (ICCTCT), 2018, pp. 1-3, doi: 10.1109/ICCTCT.2018.8550989.

16. A. A. Yadav, I. Garg and D. P. Mathur, "PACT - Programming Assistant ChaTbot," 2019 2nd International Conference on Intelligent Communication and Computational Techniques (ICCT), 2019, pp. 131-136, doi: 10.1109/ICCT46177.2019.8969070.

17. Aboodh, K. S., et al. "Solving delay differential equations by Aboodh transformation method." International Journal of Applied Mathematics & Statistical Sciences 7.2 (2018): 55-64.

18. Singh, Alka, and Rohan Benjamin. "An Analysis of Price Forecast & The Price Level Changes Owing to the Implementation of GST In India." International Journal of Financial Management (IJFM) 6.5 (2017): 1-4.

19. Singh, Komal, and Akshay Deokar. "Effects of 5S Implementation on Performance of Organization." International Journal of Business and General Management (IJBGM) 7.2 (2018): 1-14.